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Title

Orbital infections: a complete cycle 7-year audit and a management guideline

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Abstract

Objectives:

Orbital infections are regularly encountered and are managed by various healthcare disciplines. Sepsis of the orbit and adjacent tissues can be associated with considerable acute complication and long term sequelae. Therefore, prompt recognition and management of this condition are crucial. This article presents the outcomes of a 7-year complete cycle audit project and describes the development of the new local guideline on the management of orbital infections in our tertiary centre.

Methods:

1. A retrospective 5-year audit cycle on patients with orbital infections
2. A review of available evidence on the management of orbital infections
3. A new local multidisciplinary guideline on the management of orbital infections
4. A retrospective 2-year second audit cycle to assess the clinical outcomes

Results:

Various disciplines intersect in the management of orbital infections. Standardising the management of this condition proved to be achievable through the developed guideline. However, room for improvement in practice exists in areas such as the promptness in referring patients to specialist care, the multidisciplinary assessment of patients on admission, and the improvement of scanning requests of patients.

Key words:

Orbital infection– Para-nasal Sinus Disease – Sinusitis - Practice Guideline – Clinical audit

Introduction

Infections of the orbit and surrounding tissues vary in their severity and in the definitions that are assigned to them in the literature [1-3]. Although the reported incidence differs in the literature, there is agreement that orbital infections are seen regularly in tertiary centres, and that they have a higher prevalence and a greater frequency of complications in children [1, 4-7].

Orbital infections can be categorised according to the extent of sepsis (pre-septal / periorbital vs. Post-septal / orbital) [3, 8, 9], or according to the severity (cellulitis / subperiosteal abscess / intra-orbital abscess). The most universally used classification, that combines the extent and severity of the infection, is that of Chandler et al (Table 1) [1, 10, 11, 12].

The source that instigates the septic chain is predominantly the para-nasal sinuses [1, 13]; however, the infection can spread from any of the neighbouring structures [13, 14]. Historically, *Haemophilus Influenzae*, prior to its inoculation, had been recognised as the commonest microbial culprit. Thereafter, the most commonly yielded microbes from orbital sepsis specimens have become various *Streptococcus* and *Staphylococcus* species [11, 15, 16, 17].

Poorly managed orbital infections can cause severe and life threatening sequelae such as blindness and intracranial complications [1, 12, 14, 18]. The severity of the disease and the incidence of complications have been limited greatly due to the developments in diagnostic and remedial abilities; however, evidence of morbidity and mortality still exists [20]. For instance, there is an up to 10% incidence of blindness that is reported in cases where the treatment of orbital sepsis was delayed [18, 19]. Hence, there is a call for a shift towards a clinical practice that focuses on early recognition and intervention [11, 18].

The clinical assessment of orbital infections can be challenging especially in younger people. Moreover, the clinical examination can be insufficient solely as a tool to identify the severity of the disease [18]. Computed tomography (CT) is considered to be the gold standard complimentary test that identifies the formation of abscesses, their extension, the presence of intracranial complications, and the presence of associated sinus disease[3, 9, 11, 18]. While considering the risks of radiological exposure, clinicians should consider CT imaging with contrast (of the brain, orbits and sinuses) when abscesses or further complications are suspected [11, 18, 25].

Due to the various initial sources of infection, the diversity of patients' demographics, and to the wide spectrum of complications, many disciplines overlap during the management of orbital infections. The literature provides little evidence on who should manage and how they should manage the patient with orbital sepsis [1, 5, 13, 21]. Thus, different protocols are available in the literature regarding the management of orbital infections [22]; for instance, one of the known guidelines in the UK is that by Howe and Jones (2004) [3, 23, 24]. More recently, ENT UK published revised guidelines on the management of orbital cellulitis for adults and paediatric patients [25].

In this article we present a 7-year complete cycle audit project that aimed to systematically evaluate and standardise our clinical practice regarding the management of orbital infections. In this project, we examined the practice in our tertiary centre regarding orbital infections retrospectively for five years [26]. The data was thereafter compared to the most recently available evidence through a comprehensive literature review. The outcomes of the comparison were employed thereafter to construct a multidisciplinary local guideline on the management of orbital infections. Following the implementation of the guideline, a second two-year cycle of retrospective data was carried out in order to evaluate the change that had

been achieved. The article provides analysis of the final outcomes of the project and suggests further steps that can be taken in order to allow future improvements in patients' care.

Methodology:

1- First cycle

We performed a retrospective data collection regarding patients who had an admission and a diagnosis of an orbital infection in our tertiary centre over 5 years (2008-2012). Patients were recognised through a systematic coding approach (we searched the codes of: orbital infection, periorbital infection, orbital cellulitis, periorbital cellulitis, orbital abscess, periorbital abscess, orbital sepsis, periorbital sepsis and subperiosteal abscess). The coded list was reviewed and data that was related to coding errors was disregarded. The remaining patients' notes were then obtained and reviewed so only patients who had orbital infections were included in the analysis. All patients' data was assigned to an audit performa to assess all relevant details of our practice. The data was collected from after the year 2007 as the first international guideline (the European Position Paper / EPOS) for managing sinusitis and its complications by EPOS was first published in 2005/2006.

2- Literature review[24]

A review of the literature was performed through a systematic search of available evidence on the databases of Embase, Medline and Cochrane.

The used terms were 'orbital', 'periorbital', 'peri-orbital', 'cellulitis', 'infection', 'sepsis', 'abscess' and 'subperiosteal'. The search was limited to articles that had been published in English language since the year 2006. The year limitation was considered to be in keeping with the publication of the European Position Paper (EPSO).

The primary search revealed 936 papers that matched the search criteria. These underwent a title reviewing then a full text reviewing stages prior to identifying a final list of 17 articles that were included in the analysis.

3- Guideline development [24]

The results of the literature review and of the first cycle of data were employed to develop a local guideline for the management of orbital infections. The findings were incorporated and analysed collectively to construct a draft for the proposed guideline. The resultant draft underwent thereafter “closed-circuit” multidisciplinary scrutiny and amendments by specialists in emergency medicine, microbiology, ophthalmology, otolaryngology, paediatrics and radiology. Further reviews of the guideline were carried out through discussions at multiple departmental meetings. The final guideline took the design of a care pathway flowchart fitting an A4 single sided sheet and an appendix of a similar size (Figures 1&2). This was approved by the Trust’s Medical Director and became integrated within our local guidelines and policies. In order to effectively produce an improvement in our practice regarding orbital infections, we provided clinicians’ teaching, notified clinicians of the guideline via emails, and incorporated the guideline on the Trust’s intranet.

4- Second cycle

Following the described intervention, we carried out a second cycle of data reviewing over a 2-year period (2014-2015). The two-year sample size represents a convenience sampling method that allows sufficient numbers for data comparison. The patients search in the second cycle followed the same systematic coding approach, and the resulting data was assigned to the same audit performa. Data from the first and second cycles was compared in order to measure changes in our practice and quality of care.

Results (Tables 2-7)

54 patients during the first audit cycle (2008-2012) and 30 patients during the second cycle (2014-2015) were admitted to Plymouth Hospitals NHS Trust (PHNT) with orbital infections. Therefore, the incidence of inpatient admissions for orbital infections varied from 10.8 per annum in the first cycle to 15 per annum in the second. Most patients (74% in 1st cycle vs. 70% in 2nd cycle) were under the age of 17, while 26% of the 1st cycle patients and 30% of 2nd cycle patients were adults. The mean age of paediatric patients varied from 5.8 to 6.2 years between both cycles while the adult mean age was 51 years in both cycles. In both audit cycles, most patients (70% in 1st and 87% in 2nd) had a diagnosis of a cellulitis (Chandler's grades I-II). The incidence of subperiosteal and orbital abscesses (Chandler's grades III-IV) varied from 30% and 13% between the first and second cycles. No patients had had any retro-orbital complications (Chandler's grades V) during the studied periods. The commonest source of patients' primary referral in both cohorts (63-64%) was from primary care. Other patients were mainly (33%) referred from the emergency department and ophthalmology clinics.

In the first studied cohort, the referral of patients to specialist secondary care had been delayed in 17% of cases, and all of these delays occurred in primary care. Despite the implementation of the changes, this percentage escalated to reach 33% of delayed referrals in the second studied cohort. Delays in referrals in the second cycle originated mostly (80%) from primary care; however, 20% of delays originated from the emergency department. According to the agreed guideline, all patients should receive a multidisciplinary (MTD) review promptly on admission (ENT +/- paediatrics +/- ophthalmology). The adherence to this decreased slightly from 52% of patients prior to implementing the guideline to 43% afterwards.

Promptness in (within 4 hours of presentation) administering IV antibiotics was measured only in the second cycle and our compliance with this was achieved in 87% of patients.

Similarly, the compliance with the antibiotics choice was measured only in the second cycle and was found appropriate in 83% of patients. The use of intravenous Co-Amoxiclav as the agreed antibiotic of choice had increased between the audit cycles from 47% to 63% of cases. In both data cycles, topical steroids were used in less than 40% of patients and decongestants were used in less than 50% of the cases.

The implementation of the guideline succeeded in reducing the need to contact the on call microbiologist from 30% of cases in the first cycle to 13% in the second. Our practice in obtaining samples for cultures on admission of patients with orbital infections had improved from 48% prior to implementing the guideline to 80% afterwards. Of the obtained samples for cultures, 46% in the first cohort and 58% in the second cohort had yielded positive results. Staphylococcus and Streptococcus strains constituted the most commonly (59% of positive cultures) isolated microbial species in both cycles. One patient in the second cycle had Haemophilus Influenzae isolated in their cultures. The second cycle of data revealed that the most successful culture samples in growing bacteria (sensitivity) were the intra-nasal and intra-operative samples (66% to 89%). Blood cultures sensitivity was limited to around 20% according to our data.

The use of imaging had successfully decreased after the implementation of the guideline from 50% to 20% during the patients' admission period, and from 37% to 10% on the day of admission. However, our compliance with the guideline with regards to CT scanning patients who have high risk features had worsened from 13% to 77%. Most patients in both cohorts were managed conservatively (72% vs. 87%). It is notable that we were more successful after the implementation of the guideline in managing high risk patients medically without the need for surgery; 73% of high risk patients in the first cycle had surgical drainage as oppose to 23% of them in the second cycle.

The mean of the duration of patients' in-hospital stay varied from 3.9 days in the first cycle to 4.4 in the second. Outpatient follow-up planning had increased successfully after applying the guideline from 43% in the first cycle to 67% of patients in the second. One death occurred in the first cycle in an elderly patient with multiple co-morbidities as a result of a cardiac event and multiple organ failure.

Discussion

The incidence of admissions to hospitals due to orbital infections in the literature varied from 4 to 24 patients per annum; in our cohorts of data the incidence was 11 to 15 patients annually.

In our data from both cycles and from our literature review, the most commonly identified microbial culprits were staphylococcus and streptococcus species. Other microbes included MRSA, anaerobes and mixed other organisms. The sensitivity of cultured sites varied widely in literature, but most studies agreed with our findings that samples obtained during surgical procedures were the most productive.

The incidence of abscess formation differed broadly both in the literature (incidence from 1% to 83%) and in our audit data arms (13% and 30%). Similarly, imaging using CT scanning varied in the reported literature widely from 12% to 92% of patients. In our audit, the use of CT had declined from 50% of cases prior to the implementation of the new guideline to 20% afterwards.

Co-Amoxiclav and / or Cefalosporins were found to be the most frequently used antibiotics in the literature review. Intravenous Co-Amoxiclav was used in 47% of patients with orbital infection in our first audit cycle. After it was considered the antibiotic of choice in the new guideline, this percentage became 63% in the second audit cycle.

We estimated from the literature a mean duration of hospitalisation of 4.24 days for patients with orbital infections. The mean of the inpatient stay in our audit ranged from 3.9 days in the first cycle to 4.4 days in the second.

Conclusion

Orbital infections are relatively commonly seen; they require a hospital admission rate of once to twice monthly and an inpatient duration of stay of around four days. Orbital sepsis is more frequent in children and can be associated with abscess formation and retro-orbital complications. Our tertiary centre audited its practice and initiated a local guidance regarding the management of orbital infections.

Despite the implementation of the new guideline delays are still being seen in referring patients with suspected orbital infections for a specialist review. Reducing these delays requires the extension of teaching regarding the local guidance to primary care practitioners. Moreover, reducing these delays effectively necessitates that we also support secondary care doctors' teaching in order to enhance their awareness of the implemented guideline. Such teaching is also required in order to improve our adherence to ensuring the prompt multidisciplinary assessment of patients with orbital infections. Nevertheless, we observe from our data that the decision making process regarding imaging in high risk orbital infections patients should be optimised.

The guideline implementation was associated with promptness in administering IV antibiotics and with compliance with an agreed antimicrobial therapy. Moreover, an increased tendency to obtain microbial samples from patients had been observed after the application of the guideline. Samples that carry pus (eye, nose, intra-operative) are noted to be more productive in identifying a causative organism. Fewer patients with orbital infections were scanned following the implementation of the agreed management protocol. However, we succeeded in

managing high risk patients more conservatively after applying the new guidance. Another improvement in our practice between our audit cycles is the success in following orbital infections patients up in outpatients more frequently.

To conclude, there is an observable improvement in the local practice that is associated with the implementation of the constructed guideline on the management of orbital infection.

However, further steps are required in order to develop our care of orbital infections patients.

Additional actions for future progress can include:

- 1- The provision of further clinician teaching in secondary care (continued medical education 'CME' meetings, Foundation Doctors' teaching)
- 2- Primary care practitioners teaching (GP trainees' training days, GP continued medical education 'CME' activities)
- 3- The Integration of the guideline into the emergency department electronic folders of guidelines, protocols and procedures
- 4- An further email based communication to all local doctors regarding the standardised management of patients with orbital infections
- 5- Liaising with the clinical departmental leads of the departments of emergency medicine, ENT, maxillo-facial surgery, ophthalmology, paediatrics, and plastic surgery in order to include orbital infections teaching during their departmental teaching activities
- 6- Repeating a third audit cycle to highlight the long-term compliance with the agreed local gold standard

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Ethical considerations:

The formal local ethical procedures were followed and patients' data were anonymised throughout the project. A formal application to the local clinical audit department was submitted and approved prior to initiating the project data collection. Regular feedback to the clinical audit department was provided throughout the progress of the project. The clinical guideline was formally approved by the Medical Director, Assistant Medical Director, and was reviewed by the Patient Safety team and the Quality facilitators. No patient identifying data was retained during data collection. The first and third authors are the developers of the clinical guideline and permit the use of the guideline for the purposes of publication. During the development of the clinical guideline, multiple "versions" were produced gradually until the approval of a final version which was published as "version 1" on the Trust's guidelines portal. The guideline "version 1" was reviewed in 2017 and remained unchanged and therefore remains named as "version 1".

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Contributors:

The manuscript was created by

- Mr Mihiar Atfeh (manuscript writing up and editing)
- Dr Kathryn Singh (manuscript check and submission)
- Professor Hisham Khalil (manuscript final editing and reviewing)

The data collection was carried out by

- Mr Mihiar Sami Atfeh (both cycles)
- Dr Rosalind Mole(a final year medical student at the time - 1st cycle)
- Dr Oliver Froud (a final year medical student at the time - 2nd cycle)
- Dr Kathryn Singh (a final year medical student at the time - 2nd cycle)
- Dr Agnes Tulwin (a final year medical student at the time – 2nd cycle)

The literature review was carried out by the first author Mr Mihiar Atfeh.

The contributors to the multidisciplinary reviewing of the developed guideline were:

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Conflict of interest:

None to declare

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Tables & Figures

Table 1 - Chandler's classification of orbital infections

Chandler's Stage	Clinical Stage
I	Preseptal cellulitis
II	Orbital cellulitis
III	Subperiosteal abscess
IV	Orbital Abscess
V	Cavernous sinus thrombosis

Table 2 - Audit data - Demographics

Data measured	1 st Cycle	2 nd Cycle
Number of patients	54	30
Period studied	5 years	2 years
Age	74% paediatrics (mean age 5.8) 26% adults (mean age 51)	70% paediatrics (mean age 6.2) 30% adults (mean age 50.9)
Chandler's grade		
I – II	70%	87%
III	20%	10%
IV	10%	3%

Table 3 - Referral, admission and final outcomes

Data measured	1 st Cycle	2 nd Cycle
Referral source		
Primary care	63%	64%
Emergency Dept.	22%	30%
Ophthalmology	11%	3%
Other	4%	3%
Delayed referrals	17% delays in referrals All delays from primary care	33% delayed referrals 80% delays from primary care 20% delays from Emergency Dept.
Prompt multidisciplinary team (MDT) on admission	52%	43%
Microbiologist involvement		
Any time	30%	13%
On admission day	7%	7%
Length of in-patient stay	3.9 +/- 3.5 days (Median 4)	4.43 +/- 3.5 days (Median 3.5)
Outpatient Follow up		
Any	43%	67%

ENT	37%	20%
Rhinitis diagnosis on follow up	45% (of ENT follow ups)	(17% of ENT follow ups)
Death	1	0

Table 4 - Microbiological outcomes

Data measured	1 st Cycle	2 nd Cycle
Cultures		
None done	52%	20%
Negative	26% (54% of total cultures)	33% (42% of total cultures)
Positive	22% (46% of total cultures)	47% (58% of total cultures)
Cultures results		
Negative	54%	42%
Positive		
Staphylococcus	12%	17%
Aureus	8%	13%
Aureus PVL	4%	0
Epidermis	0	4%
Streptococcus	15%	17%
Group A Haem.	4%	8.5%
Intermedius	4%	8.5%

Anginosus	4%	0
Pneumoniae	4%	0
Anaerobes	4%	0
H. Influenzae	0	4%
Mixed	15%	21%
Cultures sites		
Blood Cx done	30%	63% (of whom 21% positive)
Nasal Cx done	11%	10% (of whom 66% positive)
Eye Cx done	30%	60% (of whom 89% positive)

Table 5 - Medical management

Data measured	1 st Cycle	2 nd Cycle
Antibiotics protocol compliance	NA	83%
Promptness of IV antibiotics administration	Not measured	87%
Antibiotics choice	IV Co-Amoxiclav 47% Oral Co-Amoxiclav 21% Co-Amoxiclav had to be stopped and changed 9%	IV Co-Amoxiclav 63% Oral Co-Amoxiclav 7% Co-Amoxiclav had to be stopped and changed 7%

	Combined IVI 9%	Combined ABX 20%
	Other than Co-Amoxiclav 14% (4% allergic)	Ceftriaxone +/- Met 17% Topical only 3%
Other medications		
IV Steroids	None	3%
Top Steroids	37%	33%
Decongestants	48%	43%

Table 6 - Imaging

Data measured	1 st Cycle	2 nd Cycle
Imaging		
Anytime	50%	20%
On admission day	37%	10%
High risk on admission	28%	43%
High risk – not had CT	13% (OF HIGH RISK)	77%

Table 7 - Surgical management

Data measured	1 st Cycle	2 nd Cycle
Surgery	28%	13%
High risk - no surgery	27% (of high risk)	77% of high risk

Revision surgery	13%	7%
Delayed theatre	None	None

Figure 1 - Guideline page 1/2

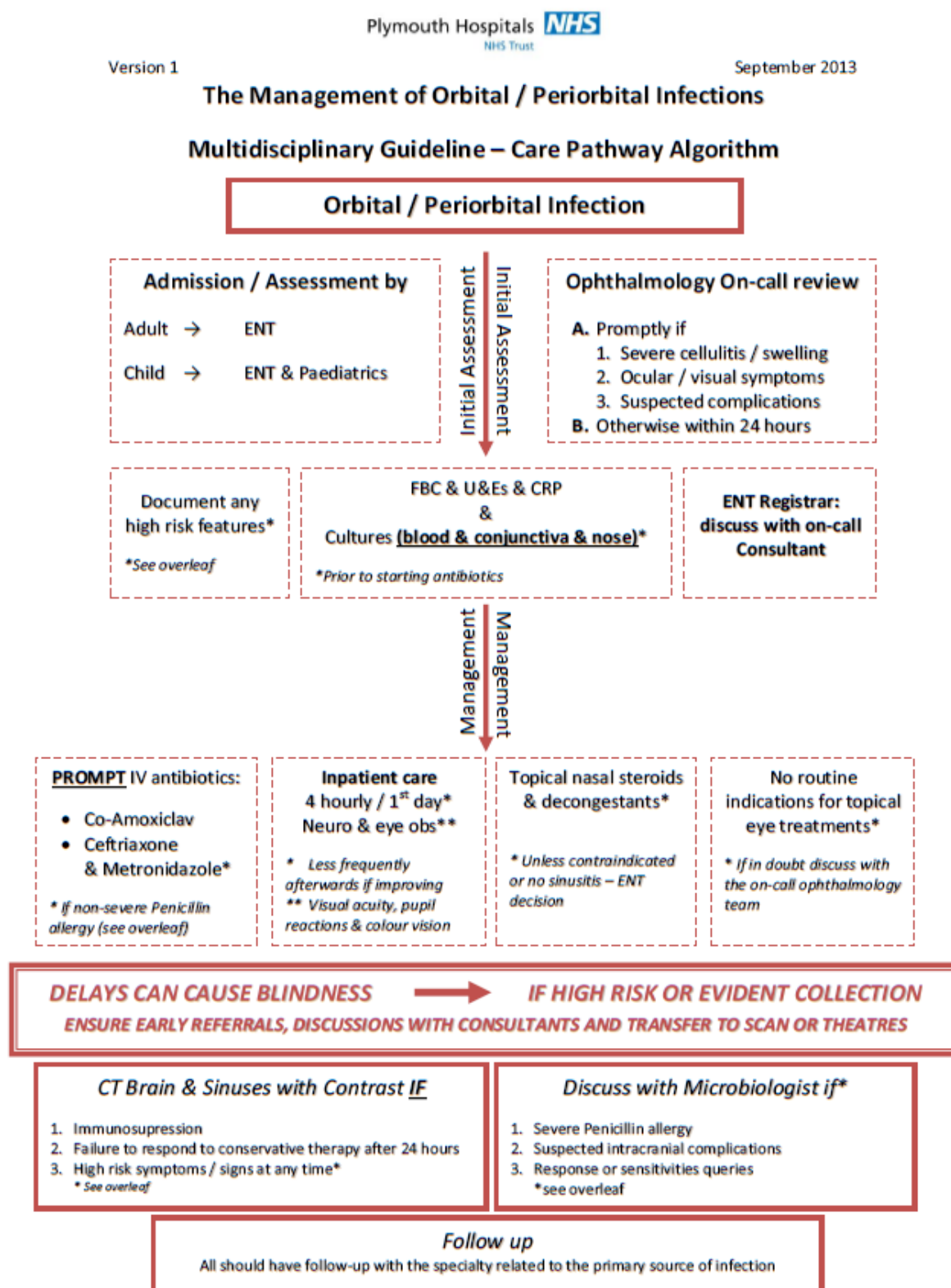



Figure 2 - Guideline page 2/2

Plymouth Hospitals 	
NHS Trust	
Version 1	September 2013
The Management of Orbital / Peri-orbital Infections	
Multidisciplinary Guideline – Appendix	
Chandler et al.: Peri-orbital infections classification	
<ol style="list-style-type: none">1. Preseptal cellulitis2. Orbital cellulitis3. Subperiosteal abscess4. Orbital abscess5. Cavernous sinus thrombosis / Intracranial complications	
High risk features	
<ol style="list-style-type: none">1. Blurring / reduced visual acuity2. Disturbed colour vision3. Ophthalmoplegia (restricted eye movements, double vision)4. Proptosis5. Severe swelling preventing accurate assessment of the globe6. Pupillary dysfunction (relative afferent pupil defect)7. Any sclera changes8. Any neurological signs9. Bilateral periorbital oedema	
Antibiotics notes: <i>If in doubt refer to Trust policy / discuss with on call Microbiologist</i>	
<ul style="list-style-type: none">• Penicillin allergy<ol style="list-style-type: none">1. Type 1 anaphylaxis / urticaria / Stephens-Johnson's: Avoid all Beta Lactams (penicillins / Cephalosporins / Carbapenems / Aztreonam)2. Non-urticarial rash to Penicillins: Can receive a Cephalosporin in a controlled environment• Ceftriaxone is a restricted access antibiotic	
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